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Attending and intending

Lauren Stewart

The presentation of a central visual cue can be used to orient subjects' attention in space (known as covert orienting). In the now classic Posner task, a cue can be a valid or invalid predictor of the location at which an event subsequently occurs. The difference in the time taken to detect the target when its location is validly cued (i.e. in the location where it actually appears), as opposed to invalidly cued, is one index of the effect of attention on information processing.

Neuropsychological and neuroimaging studies have revealed the posterior parietal cortex to have a crucial role in covert orienting, and the involvement of this same area in the planning of eye movements has led to the suggestion that covert orienting and eye-movement planning are closely related processes. Applying the same logic to other regions of the parietal cortex, areas known to be involved in forming limb-centred, rather than eye or head centred spatial representations might also be involved in mediating covert attention to motor responses.

In a recent TMS study, Rushworth et al. compared these two types of covert attention: orienting in a Posner-type task, where attention is directed to a visual dimension (spatial location), and an analogous motor task where attention is directed to a motor response¹. Rushworth hypothesized that the posterior parietal cortex would be involved only in visual attention whereas more anterior parietal sites might be crucial for motor intention. Subjects were cued to attend to one of four possible target locations (visual task) or to prepare one of two motor responses (motor task). The subsequent appearance of the target could be congruent or incongruent with the attended location/prepared response. TMS was systematically applied over several candidate parietal sites in order to disrupt processing (transiently and reversibly) in these areas while subjects performed the tasks. In the visual-orienting task, stimulation over a right posterior parietal site (angular gyrus), produced significant increases in reaction times to invalidly cued targets. By contrast, during the motororienting task, stimulation over a more anterior parietal site (the supramarginal gyrus), this time in the left hemisphere, produced slowing of reaction times, again to invalidly cued trials only.

The results suggest that two anatomically distinct regions of parietal cortex, one anterior, one posterior, subserve analogous attentional and intentional processes in the visual and motor system respectively. The distinct role of these two parietal sites for different types of orienting is consistent with anatomical and neurophysiological findings from homologous areas in the macaque, as well as with neuroimaging results from humans. Rushworth et al.'s study demonstrates how such data can constrain hypotheses regarding functional dissociations, which can be subsequently tested with an interference method, such as TMS.

¹ Rushworth, M.F.S. et al. (2001) Complementary localization and lateralization of orienting and motor attention. *Nat. Neurosci.* 4, 656–661